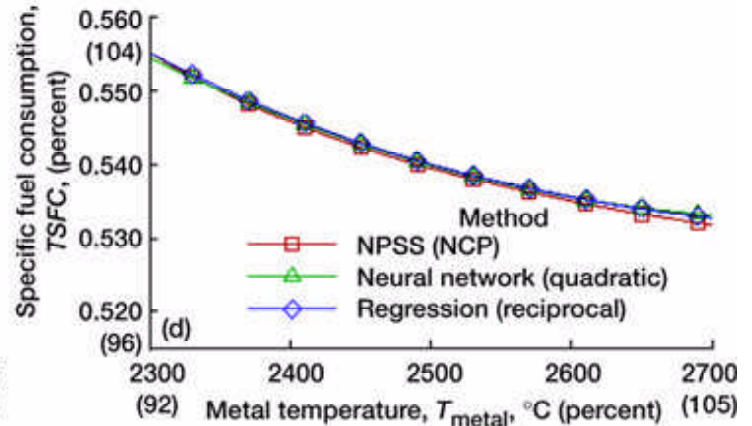
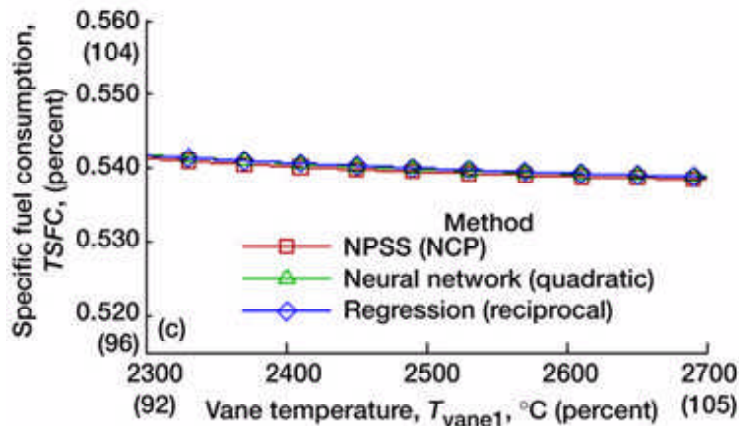
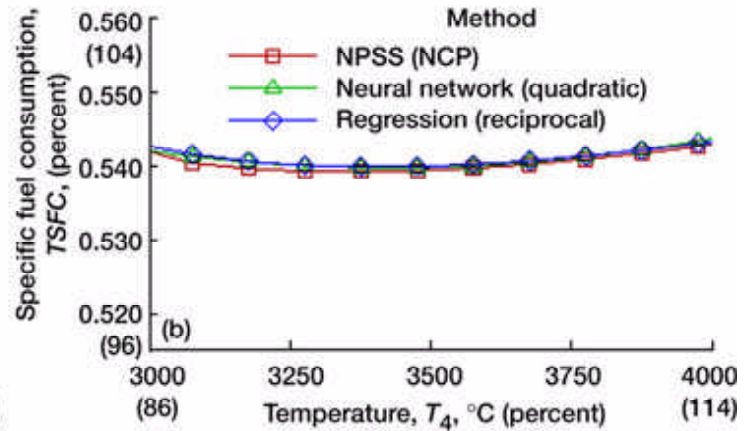
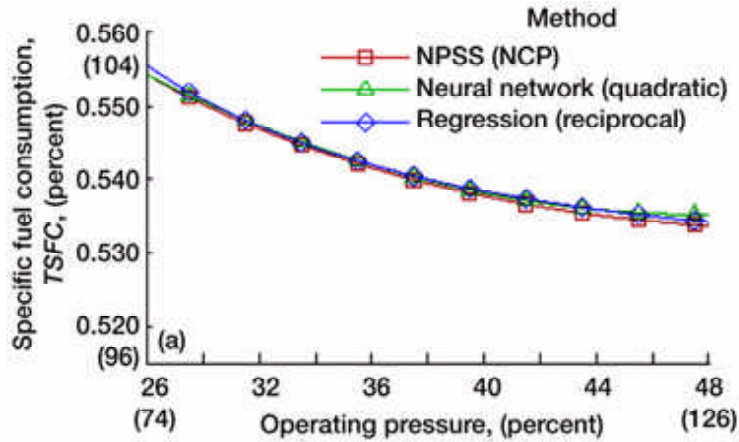


Neural Network and Regression Soft Model Extended for PAX-300 Aircraft Engine

In fiscal year 2001, the neural network and regression capabilities of NASA Glenn Research Center's COMETBOARDS design optimization testbed were extended to generate approximate models for the PAX-300 aircraft engine. The analytical model of the engine is defined through nine variables: the fan efficiency factor, the low pressure of the compressor, the high pressure of the compressor, the high pressure of the turbine, the low pressure of the turbine, the operating pressure, and three critical temperatures (T_4 , T_{vane} , and T_{metal}). Numerical Propulsion System Simulation (NPSS) calculations of the specific fuel consumption (TSFC), as a function of the variables can become time consuming, and numerical instabilities can occur during these design calculations. "Soft" models can alleviate both deficiencies. These approximate models are generated from a set of high-fidelity input-output pairs obtained from the NPSS code and a design of the experiment strategy. A neural network and a regression model with 45 weight factors were trained for the input-output pairs. Then, the trained models were validated through a comparison with the original NPSS code. Comparisons of TSFC versus the operating pressure and of TSFC versus the three temperatures (T_4 , T_{vane} , and T_{metal}) are depicted in the figures. The overall performance was satisfactory for both the regression and the neural network model. The regression model required fewer calculations than the neural network model, and it produced marginally superior results. Training the approximate methods is time consuming. Once trained, the approximate methods generated the solution with only a trivial computational effort, reducing the solution time from hours to less than a minute.



PAX-300 engine performance results compared with the specific fuel consumption (TSFC) calculated by soft models. (a) Operating pressure versus TSFC. (b) T_4 versus TSFC. (c) T_{vane} versus TSFC. (d) T_{metal} versus TSFC.

Long description Graphs of specific fuel consumption versus operating pressure, T_4 temperature, vane temperature, and metal temperature for three different methods: NPSS (NCP), neural network (quadratic), and regression (reciprocal).

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